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22850 7590 08/18/2009

OBLON, SPIVAK, MCCLELLAND MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER	
PARK, EDWARD	
ART UNIT	PAPER NUMBER
2624	

DATE MAILED: 08/18/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/517,615	06/10/2005	Hirotaka Suzuki	262520US6PCT	8515

TITLE OF INVENTION: IMAGE RECOGNITION DEVICE USING FEATURE POINTS METHOD FOR RECOGNIZING IMAGES USING FEATURE POINTS AND ROBOT DEVICE WHICH RECOGNIZES IMAGES USING FEATURE POINTS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	11/18/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

22850 7590 08/18/2009

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1940 DUKE STREET
ALEXANDRIA, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

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nonprovisional	NO	$1510	$300	$0	$1810	11/18/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
PARK, EDWARD	2624	382-190000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☐ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

☐ A check is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 450 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 450 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/517,615	SUZUKI ET AL.	
	Examiner	Art Unit	
	EDWARD PARK	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *amendments and remarks received on 5/15/09*.

2. ☒ The allowed claim(s) is/are *1-23*.

3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☒ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 3/2/09
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Edward Park/ Examiner, Art Unit 2624	

EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

Response to Amendment

1. This action is responsive to applicant's amendment and remarks received on 5/15/09. Claims 1-23 are currently pending.

2. Claims 1-23 are allowed.

3. The following is an examiner's statement of reasons for allowance:

Regarding claim 1, the most relevant prior art of record, Schmid, Roehrig, with Hull combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; and model attitude estimation means for detecting the presence or absence of the model on the object image using the

candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by wherein the feature quantity comparison means itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms by sequentially shifting all of the feature points in the one of the density gradient direction histograms one by one to generate a plurality of shifted histograms, and generates the candidate-associated feature point pair by determining a shortest distance between (1) an other of the density gradient direction histograms and (2) the one of the density gradient direction histograms and the shifted histograms.

Regarding claim 5, the most relevant prior art of record, Schmid, Roehrig, with Hull combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; and model attitude estimation means for detecting the presence or absence of the model on the object image using the

candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by wherein the feature quantity comparison means itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms and generates the candidate- associated feature point pair by assuming a shortest distance to be a distance between the density gradient direction histograms, and wherein the model attitude estimation means repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an amine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space.

Regarding claim 9, the most relevant prior art of record, Schmid, Roehrig, with Hull combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-

associated feature point pair having similar feature quantities; model attitude estimation means for detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by candidate-associated feature point pair selection means for performing generalized Hough transform for a candidate-associated feature point pair generated by the feature quantity comparison means, assuming a rotation angle, enlargement and reduction ratios, and horizontal and vertical linear displacements to be a parameter space, and selecting a candidate-associated feature point pair having voted for the most voted parameter from candidate-associated feature point pairs generated by the feature quantity comparison means, wherein the model attitude estimation means detects the presence or absence of the model on the object image using a candidate-associated feature point pair selected by the candidate associated feature point pair selection means and estimates a position and an attitude of the model, if any wherein the feature quantity comparison means itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms and generates the candidate-associated feature point pair by assuming a shortest distance to be a distance between the density gradient direction histograms.

Regarding claim 10, the most relevant prior art of record, Schmid, Roehrig, with Hull combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and

retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; and model attitude estimation means for detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by wherein the feature quantity comparison means itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms and generates the candidate- associated feature point pair by assuming a shortest distance to be a distance between the density gradient direction histograms, and wherein the feature point extraction means extracts a local maximum point or a local minimum point in second-order differential filter output images with respective resolutions as the feature point, i.e., a point free from positional changes due to resolution changes within a specified range in a multi-resolution pyramid structure acquired by repeatedly applying smoothing filtering and reduction resampling to the object image or the model image.

Regarding claim 11, the most relevant prior art of record, Schmid, Roehrig, Lowe with Matsuzaki combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and retaining a feature quantity in a neighboring region at the feature point in each of the object image and the model image, the feature quantity being a density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities~ each candidate-associated feature point pair including one feature point of the object image and one feature point of the model image; and model attitude estimation means for detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, Lowe with Matsuzaki combination by wherein the model attitude estimation means repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space.

Regarding claim 14, the most relevant prior art of record, Schmid, Roehrig, Lowe with Matsuzaki combination, teaches feature point extracting means for extracting a feature point

from each of the object image and the model image; feature quantity retention means for extracting and retaining a feature quantity in a neighboring region at the feature point in each of the object image and the model image, the feature quantity being a density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; model attitude estimation means for detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, Lowe with Matsuzaki combination by candidate-associated feature point pair selection means for performing generalized Hough transform for a candidate-associated feature point pair generated by the feature quantity comparison means, assuming a rotation angle, enlargement and reduction ratios, and horizontal and vertical linear displacements to be a parameter space, and selecting a candidate-associated feature point pair having voted for the most voted parameter from candidate-associated feature point pairs generated by the feature quantity comparison means, wherein the model attitude estimation means repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space, and wherein the

model attitude estimation means detects the presence or absence of the model on the object image using a candidate-associated feature point pair selected by the candidate-associated feature point pair selection means and estimates a position and an attitude of the model, if any. Regarding claim 15, the most relevant prior art of record, Schmid, Roehrig, Lowe with Matsuzaki combination, teaches feature point extracting means for extracting a feature point from each of the object image and the model image; feature quantity retention means for extracting and retaining a feature quantity in a neighboring region at the feature point in each of the object image and the model image, the feature quantity being a density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; model attitude estimation means for detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, Lowe with Matsuzaki combination by wherein the model attitude estimation means repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space, and wherein the feature point extraction means extracts a local maximum point

or a local minimum point in second-order differential filter output images with respective resolutions as the feature point, i.e., a point free from positional changes due to resolution changes within a specified range in a multi-resolution pyramid structure acquired by repeatedly applying smoothing filtering and reduction resampling to the object image or the model image. Regarding claim 16, the most relevant prior art of record, Schmid, Roehrig, with Hull combination, teaches at least one processor performing the steps of, extracting a feature point from each of the object image and the model image; extracting and retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate- associated feature point pair having similar feature quantities; and detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by wherein the comparing itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms by sequentially shifting all of the feature points in the one of the density gradient direction histograms one by one to generate a plurality of shifted histograms, and generates the candidate-associated feature point pair by determining a

shortest distance between (1) an other of the density gradient direction histograms and (2) the one of the density gradient direction histograms and the shifted histograms.

Regarding claim 17, the most relevant prior art of record, Schmid, Roehrig, with Lowe combination, teaches at least one processor performing the steps of, extracting a feature point from each of the object image and the model image; extracting and retaining a feature quantity in a neighboring region at the feature point in each of the object image and the model image, the feature quantity being a density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Lowe combination by comparing the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate- associated feature point pair having similar feature quantities, each candidate-associated feature point pair including one feature point of the object image and one feature point of the model image; and detecting the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any, wherein the detecting repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space.

Regarding claim 18, the most relevant prior art of record, Watanabe, Schmid, Roehrig, with Hull combination, teaches image input means for imaging an outside environment to generate the input image; feature point extracting means for extracting a feature point from each of the input image and the model image; feature quantity retention means for extracting and retaining, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the input image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; feature quantity comparison means for comparing the feature quantity of each feature point of the input image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; and model attitude estimation means for detecting the presence or absence of the model on the input image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Watanabe, Schmid, Roehrig, with Hull combination by wherein the feature quantity comparison means itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms by sequentially shifting all of the feature points in the one of the density gradient direction histograms one by one to generate a plurality of shifted histograms, and generates the candidate-associated feature point pair by determining a shortest distance between (1) an other of the density gradient direction histograms and (2) the one of the density gradient direction histograms and the shifted histograms.

Regarding claim 19, the most relevant prior art of record, Watanabe, Schmid, Roehrig, with Lowe combination, teaches image input means for imaging an outside environment to generate the input image; feature point extracting means for extracting a feature point from each of the input image and the model image; feature quantity retention means for extracting and retaining a feature quantity in a neighboring region at the feature point in each of the input image and the model image, the feature quantity being a density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Watanabe, Schmid, Roehrig, with Lowe combination by feature quantity comparison means for comparing the feature quantity of each feature point of the input image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities each candidate-associated feature point pair including one feature point of the object image and one feature point of the model image; and a model attitude estimation means for detecting the presence or absence of the model on the input image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any, wherein the model attitude estimation means repeatedly projects an affine transformation parameter determined from three randomly selected candidate-associated feature point pairs onto a parameter space and finds an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space.

Regarding claim 20, the most relevant prior art of record, Schmid, Roehrig with Hull combination, teaches a feature point extracting unit configured to extract a feature point from each of the object image and the model image; a feature quantity retention unit configured to extract and retain, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions; a feature quantity comparison unit configured to compare the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and generating a candidate-associated feature point pair having similar feature quantities; and a model attitude estimation unit configured to detect the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, with Hull combination by wherein the feature quantity comparison unit itinerantly shifts one of the density gradient direction histograms of feature points to be compared in density gradient direction to find distances between the density gradient direction histograms by sequentially shifting all of the feature points in the one of the density gradient direction histograms one by one to generate a plurality of shifted histograms, and generates the candidate-associated feature point pair by determining a shortest distance between (1) an other of the density gradient direction histograms and (2) the one of the density gradient direction histograms and the shifted histograms.

Regarding claim 21, the most relevant prior art of record, Schmid, Roehrig, Lowe with Matsuzaki combination, teaches a feature point extracting unit configured to extract a feature point from each of the object image and the model image; a feature quantity retention unit configured to extract and retain, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, Lowe with Matsuzaki combination by a feature quantity comparison unit configured to compare the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and to generate a candidate-associated feature point pair having similar feature quantities, each candidate-associated feature point pair including one feature point of the object image and one feature point of the model image, each feature quantity not including gradient magnitude information; and a model attitude estimation unit configured to detect the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any, wherein the model attitude estimation unit is configured to repeatedly project an affine transformation parameter determined from three randomly selected candidate- associated feature point pairs onto a parameter space and to find an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space.

Regarding claim 23, the most relevant prior art of record, Schmid, Roehrig, Lowe with Matsuzaki combination, teaches a feature point extracting unit configured to extract a feature point from each of the object image and the model image; a feature quantity retention unit configured to extract and retain, as a feature quantity, a density gradient direction histogram at least acquired from density gradient information in a neighboring region at the feature point in each of the object image and the model image, the density gradient direction histogram storing a number of points near the feature point having each of a plurality of gradient directions (see Non-Final Rejection on 2/17/09).

Applicant's claimed invention distinguishes over the Schmid, Roehrig, Lowe with Matsuzaki combination by a feature quantity comparison unit configured to compare the feature quantity of each feature point of the object image with the feature quantity of each feature point of the model image and to generate a candidate-associated feature point pair having similar feature quantities, each feature quantity not including gradient magnitude information; and a model attitude estimation unit configured to detect the presence or absence of the model on the object image using the candidate-associated feature point pair and estimating a position and an attitude of the model, if any, wherein the model attitude estimation unit is configured to repeatedly project an affine transformation parameter determined from three randomly selected candidate- associated feature point pairs onto a parameter space and to find an affine transformation parameter to determine a position and an attitude of the model based on an affine transformation parameter belonging to a cluster having the largest number of members out of clusters formed on a parameter space, and wherein the feature quantity comparison unit is configured to generate the dissimilarity for each respective candidate-associated feature point

pair by itinerantly shifting by one step the plurality of gradient directions for one of the object image and the model image to compute a number of similarities to a number of the plurality of gradient directions, and to take a minimum dissimilarity to be the dissimilarity.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to EDWARD PARK whose telephone number is (571)270-1576. The examiner can normally be reached on M-F 10:30 - 20:00, (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on (571) 272-7413. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Edward Park
Examiner
Art Unit 2624

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/Brian Q Le/
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